Outcrop Based, Architectural and Facies Analysis of Early Jurassic Fluvial-Eolian Interactions: The Interfingering of the Kayenta Formation and the Navajo Sandstone in and Around Kanab, Utah

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Abstract

The Navajo erg covered much of the Southern Colorado Plateau during the Early Jurassic Period. The establishment of this massive erg can be identified in the preserved rock record around Kanab, Utah by successive advances over the marginal alluvial plain. The gradual advances of the Navajo Sandstone (Navajo) eolian complex comprise three distinctly identifiable units separated by two fluvial units of the Kayenta Formation (Kayenta). Through the use of detailed outcrop vertical sections, fluvial architectural element analysis and petrographical study, a depositional facies analysis is developed for the outcrop exposures around Kanab, Utah. A climatic control is proposed for the observed interfingering of the Navajo and the Kayenta.

In the 36 km^2 study area, the complete Kayenta-Navajo vertical section is approximately 300 m in total thickness. The alluvial transport direction of the Kayenta is consistently oriented in a north to northwest direction, which is transgressed by the opposing eolian deposits in three main advances from the south and southeast. Changes in Kayenta fluvial regimes through time within the units are analyzed in 2D field outcrop sections and indicate a transition from large ephemeral channel systems to distal unconfined flow conditions near the erg margin. Kayenta fluvial units generally display little influence of eolian input. However, petrographical evidence from the transitional fluvial facies commonly shows eolian detrital grains. The floodplain deposits of the corresponding fluvial units have poorly to well-developed paloesol and caliche horizons. These pedogenic features observed at certain horizons preserve important paleoenvironmental indicators. Eolian facies show minor changes through time, with small cross beds preserved near transitions zones and large (>30m) cross beds further up sections. Soft sediment deformation (SSD) has been widely identified in the Navajo eolian units, especially underlying fluvial or interdune units. The identification of the SSD horizons is applied as a proxy for the wetting of the erg system, likely by a rising water table.

The interfingering of the Kayenta-Navajo represents an incomplete record of the entire dryland system, compared to other analogues. Nonetheless, three major drying-up cycles are proposed for the outcrop exposures in the study area, which are locally and regionally identifiable. These fluvial-eolian interactions point largely to a climatic control; however, it is difficult to isolate the effects of other allogenic controls such as tectonism and/or eustasy.